

Terpenes

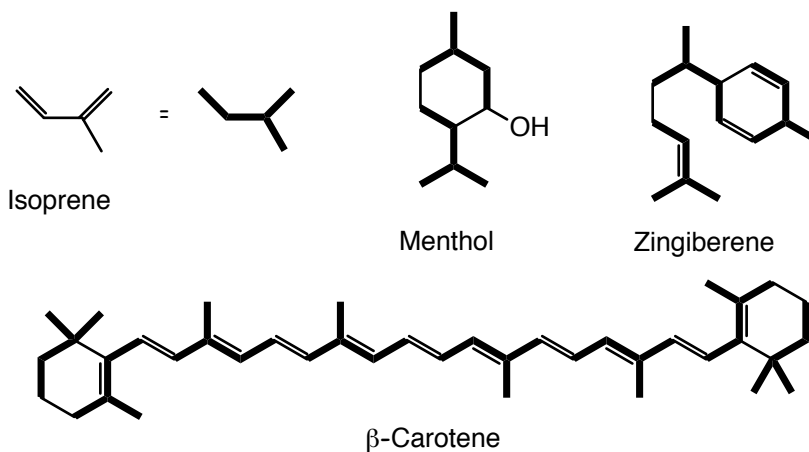
Medicinal compounds found in nature are also called natural products, or sometimes "secondary metabolites." Most of them fall into a few main categories, here we focus on terpenes.

Terpenes are found in both plants and animals. In plants, terpenes show up all over the place, but some of the best known are plants in the lamiaceae or mint family which are replete with terpenes, and many are used in cooking (mint, oregano, basil, rosemary) or in perfumes (lavender). Conifers including pines and cedars also contain terpenes (e.g. the smell of pine trees). Most essential oils are mixtures of terpenes. In animals, the most important pathway involving terpenes is the biosynthesis of cholesterol, which is of huge medical importance.

By the way, if these are secondary metabolites, what are the primary metabolites? Carbohydrates (sugars), lipids (or fats), proteins and nucleic acids. An organism typically cannot live for more than a few days if the primary metabolites are not available (think starvation). Secondary metabolites are more important to the long term survival of an organism, or to the survival of a population.

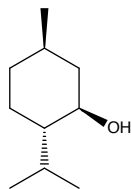
There are many terpenes known, but they are all built from 5-carbon pieces and thus usually have 10, 15, 20, 30 or 40 carbons in their structure. They are largely composed of a carbon framework decorated with oxygen-containing functional groups (nitrogen is extremely rare in terpenes). Note: sometimes a couple of carbons are lost during the biosynthesis of a terpene, so they don't always have a carbon count which is exactly a multiple of five.

How to recognize a terpene: Look for the following branched C₅ piece in the structure. It should be present multiple times. This piece is related to a molecule called isoprene, which isn't actually present in plants, but we still say that terpenes follow the "isoprene rule."

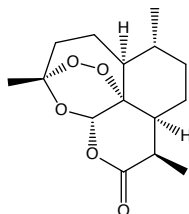


Important subcategories of terpenes on shown on the next page

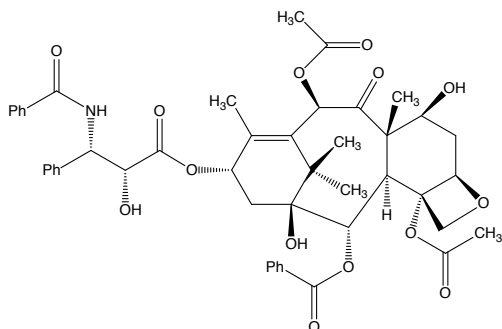
- Monoterpenes (C_{10}). Menthol, found in cough drops.



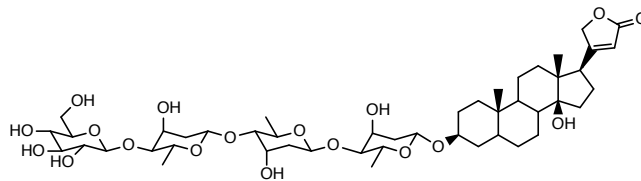
- Sesquiterpenes (C_{15}). Artemisinin, the anti-malarial compound identified by study of Traditional Chinese Medicine.



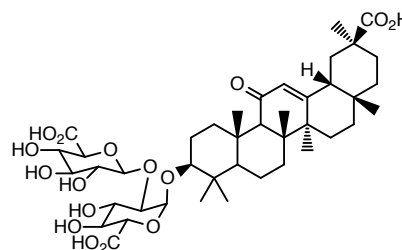
- Diterpenes (C_{20}). Taxol is a very important anti-cancer agent. Note that the ester groups are "decorations" on the core structure of taxol and are not counted as part of the C_{20} .



- Triterpenes (C_{30}). Digitalis is a "cardiac glycoside" (glycoside means it is combined with sugars). It comes from *Digitalis purpurea* which is the foxglove plant. Digitalis is used to make heart beat harder (necessary in congestive heart failure). However, too much digitalis and the heart will beat itself to death.



Glycyrrhizin is a compound found in licorice (*Glycyrrhiza glabra*). It is also a glycoside.



- Tetraterpenes (C_{40}). β -carotene is the orange pigment found in carrots. It is an anti-oxidant and is broken down in the body to form retinal (Vitamin A), which is important to eye sight. The red color of tomatoes is due to lycopene (not shown).

